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EFFECT OF NON-EXPOSURE TO SUNLIGHT ON VITAMIN D STATUS OF FREE LIVING POPULATION

AFIFA JAHAN &MANORAMA KANURI

Department of Food and Nutrition, Post Graduate and Research Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, India

ABSTRACT

Vitamin D can play a role in decreasing the risk of many chronic illnesses. Vitamin D deficiency is pandemic, yet it is the most under-diagnosed and under-treated nutritional deficiency in the world. 1 billion people worldwide have Vitamin D deficiency or insufficiency. The purpose of the study to analyze the vitamin D level of free living population who were not exposed to sunlight and effect of supplementation. A total of 20 subjects within the age group of 22-60 years were selected for the study. 20 subjects, who were not exposed to sunlight at all during the day, were selected from a call center at Hi-tech city, Hyderabad. In places where there is a minimal sunlight, food rich in vitamin D, fortified foods in vitamin D and vitamin D supplementation should be consumed to avoid the vitamin D deficiency. Four months supplementation of 60,000 IU per week was recommended for increasing serum levels to sufficiency category

KEYWORDS: Vitamin D, Minimal Sunlight, Food Rich & Nutritional Deficiency

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Original Article

INTRODUCTION

Vitamin D deficiency is pandemic, yet it is the most under-diagnosed and under-treated nutritional deficiency in the world. 1 billion people worldwide have Vitamin D deficiency or insufficiency (Holick, 2007). It is now recognized that the function of vitamin D extends far beyond that required for calcium homeostasis.

Vitamin D can play a role in decreasing the risk of many chronic illnesses, including common cancers, autoimmune diseases, infectious diseases, and cardiovascular disease (Holick, 2007).

Sufficient sun exposure (usually 5–10 min of exposure of the arms and legs or the hands, arms, and face, 2 or 3 times per week) and increased dietary and supplemental vitamin D intakes are reasonable approaches to guarantee vitamin D sufficiency (Holick, 2004).

Vitamin D metabolism is enhanced during pregnancy and lactation. The placenta is formed at 4 weeks of gestation. (Hossein-nezhad, 2012, Kaludjerovic, 2010) From 4 weeks to full term, $25(OH)D_3$ is transferred across the placenta, and the foetal cord blood concentration of $25(OH)D_3$ is positively correlated with the mother's concentration in the blood (Shin, 2010).

Hypovitaminosis D is largely due to inadequate cutaneous production from 7-dehydrocholesterol and, to a lesser degree, from low dietary intake or impaired intestinal absorption of the vitamin (Hollick, 2008).

Vitamin D Sufficiency via sun exposure is not a tenable solution for most Indians. Vitamin D deficiency is a major health concern in India, notwithstanding the brightly shining sun. The "adequacy of exposure to sunlight

of an individual's bare skin" required to photosynthesize vitamin D is grossly ill understood. Darker skin has high melanin content which acts as a natural sunscreen.

Therefore, darker skin produces a significantly lesser amount of vitamin D when compared with the individuals with fairer skin, such as Caucasians (Lo, 1986, Clemens, 1982, and Matsuoka, 1991). Thus, for Indian skin tone, minimum "direct sun exposure" required daily is more than 45 min to bare face, arms and legs to sun's UV rays (wavelength 290–310 nm). With the exception of those who perforce the need to work outdoors in the sun, most Indians do not get adequate sun exposure to produce sufficient amounts of vitamin D endogenously.

For a fair-skinned person, if 30 minutes of summer noon-time sun would cause mild sunburn, then 10 to 15 minutes of exposure followed by good sun protection should be sufficient to produce adequate vitamin D (Holicks, 2007). Exposure of the face to sunlight does not serve much purpose, because although it is the most sun exposed of all the body areas, it provides little vitamin D_3.

An adult in a bathing suit exposed to 1 minimal erythemal dose (slight pinkness to the skin 24 hours after exposure) is equivalent to taking approximately 20,000 IU (500 mg) of vitamin D_2 orally (Holick, 2007 and Holick, 2012). Thus, exposure of arms and legs to 0.5 minimal erythemal doses is equivalent to ingesting approximately 3000 IU of vitamin D_3 (Holick, 2007 and Holick, 2011).

Intake of caffeine from tea and coffee is very high in India. Studies have reported association of high caffeine intake with increased risk of low bone mineral density, osteoporosis, and osteoporotic fractures in middle-aged women. This situation is exacerbated in women with low calcium intake, especially in lean subjects (Beaudoin, 2011).

On the other hand, the high salt content of Indian diet is likely to increase urinary calcium excretion. A direct relation between high sodium intake and lower bone mass has been reported (Caudarella, 2009).

In the scenario of inadequate calcium intake, vitamin D insufficiency and high phytate content in diet, environmental pollutants such as fluoride add insult to injury.

Toxins like fluoride affect bone metabolism severely in the conjunction with inadequate calcium intake, especially in children (Harinarayan, 2006 and Khandare, 2005).

Cooking practices in India like baking is done mostly above 175°C but the temperature in the food does not reach such high temperatures, therefore stability of vitamin D during baking is well within acceptable range (Natri, 2006).

Shallow and deep frying of foods is very popular in India. When foods are fried, vitamin D in the food comes out into the cooking medium and is thermally degraded (Lu, 2007).

Due to all these factors which might contribute to low vitamin D status in Indians, the present study has been designed to understand whether lack of exposure to sunlight in individuals due to occupational necessities could contribute to low vitamin D status, and also examine the dietary factors that could further exacerbate the condition.

Methodology

A total of 20 subjects within the age group of 22-60 years were selected for the study. 20 subjects, who were not exposed to sunlight at all during the day, were selected from a call center at Hi-tech city, Hyderabad. These subjects work in air conditioned offices and travel by cabs to the office during late evening and return back to their home during early

morning before the sun rises. Their shift timings were from 7 p.m. to 4 a.m. Hence, their exposure to sunlight is almost at zero level during week days.

Formation of Ethical Committee

An ethical committee was formed which included the doctor, a nurse, the Chairman of the advisory committee, and the analyst. The committee's approval was obtained before drawing the blood of the subjects.

Vitamin D Status was Assessed using Two Different Methods

- Information on Nutritional assessment / dietary intake was collected using a questionnaire which was designed to measure the dietary intake of all vitamin D rich food sources, quantity of intake, as well as to measure exposure of sunlight and gain access to information about the general health status and the regular intake of any vitamin D supplements**.**
- Serum vitamin D levels were assessed by HPLC using a Diode Array Detector**.** Vitamin D status in 20 subjects was assessed by measuring the serum concentration of 25-hydroxy vitamin D_3 [$25(OH)D_3$] by the method described by Turpeinen *et al*., 2003.

RESULTS AND DISCUSSIONS

The data collected from the subjects through questionnaire method was analyzed and the results are presented in Table no I. The results showed low consumption of milk, yoghurt, milk puddings, butter, cheese, breads, bread rolls, wraps, fortified vitamin D products and dietary supplements. Hence, their serum vitamin D levels found before supplementation was severely low.

The serum vitamin D levels were assessed using HPLC method described by Turpeinen *et al*., 2003, and were classified according to classification given by vitamin D status National Nutrition Council (Meyer 2006) in Table II.

From the 20 subjects selected 15 were found to be severely deficient and were given 2 months supplementation of 60,000 IU/ week. After 8 weeks of supplementation, the serum vitamin D levels were assessed and the results are presented in Table III.

Time of day during sun exposure, season, latitude, and degree of skin pigmentation dictate how much vitamin D_3 is produced during sun exposure. Exposure of the arms and legs (abdomen and back when possible) to sunlight 2 to 3 times a week for approximately 25% to 50% of the time it would take to develop a mild sunburn (minimal erythemal dose), will cause the skin to produce enough vitamin D.

For a white person, if 30 minutes of June noon-time sun would cause mild sunburn, then 10 to 15 minutes of exposure followed by good sun protection should be sufficient to produce adequate vitamin D (Holicks, 2007). There is no need to ever expose the face because although it is the most sun exposed of all the body areas, it provides little vitamin D_3.

An adult in a bathing suit exposed to 1 minimal erythemal dose (slight pinkness to the skin 24 hours after exposure) is the equivalent to taking approximately 20,000 IU (500 mg) of vitamin D_2 orally (Holick, 2007 and Holick, 2012). Thus, exposure of arms and legs to 0.5 minimal erythemal doses is equivalent to ingesting approximately 3000 IU of vitamin D_3 (Holick, 2007 and Holick, 2011). The subjects of the present study had zero exposure to sunlight and in addition, consumed very low quantities of vitamin D rich foods.

Table 1: Information on Nutritional Assessment

Type of Foods Consumed	No Exposure Group(% of Subjects)
Milk	40% consume milk
Kind of milk	80% Whole milk, 20% semi skimmed milk.
Milk in tea or coffee	60% consume
Breakfast cereal with milk	90% do not consume
Milk pudding, rice pudding or custard	20% consume
Yoghurt	20% consume
Butter/spread	10% consume.
Cheese	10% consume.
Cheese (all kinds) on pizza, on toast, on lasagne or with any other kinds of food	10% consume.
Bread, wraps, and/or rolls	15% consume
Kind of toast/bread/rolls	From 15% 5%white bread, 5% Brown bread and 5% consume Both
Fish	60% consume
Meat	90% consume
Eggs	95% consume
Cakes, chocolate and/or biscuits	40% consume
Alcohol	100% do not 90% consume
Carbonated drinks	100% consume
Beverages fortified with vitamin D and/or calcium	10% consume
Dietary supplements	10% consume
Use sunscreen	15% use

The above table shows the regular dietary intake of Vitamin D by the selected subjects. It is clearly shown that the consumption of Vitamin D rich foods, fortified products and Dietary supplements of D_3 was very, even low though these subjects were from higher income group and they can afford to purchase Vitamin D rich foods, but due to lack of interest and knowledge of importance of vitamin D, ignorance is more. Hence, these subjects can be compared with low income group where affordability of products are low due to food insecurity.

Table 2: Vitamin D Status as Per the Classification of the National Nutrition Council (Meyer 2006)

25(Oh)D In Serum or Plasma	Description
>50 nmol/l*	Sufficient
25-50 nmol/l	Suboptimal
12.5-25 nmol/l	Deficiency
<12.5 nmol/l	severe deficiency

Table 3: Vtamin D_3 Levels before and after Supplementation

Subject No.	Vitamin D Levels Before Supplementation (Severely Deficient)	Vitamin D Levels after Supplementation (Insufficient)
1	7.75	15
2	7.7	10
3	8.11	14
4	5.4	17.5
5	8.02	11.2
6	5.4	7.8

Table 3: Contd.,		
7	5.5	17
8	2	11
9	8.14	9
10	7.5	10
11	5.7	13
12	8.8	15
13	8.1	12
14	5.5	19
15	9.7	21

The above table shows the vitamin D levels before and after supplementation for two months. It is shown that before supplementation 15 out of 20 were severely deficient and after supplementation for 2 months their serum vitamin D levels were increased and they could now be classified under insufficient category. with respect to serum vitamin D_3 levels. It is evident that more 2 months supplementation is recommended for increasing serum levels to sufficiency category.

Statistical Analysis

The results of the study were analyzed statistically using a paired T–test for assessing improvement in vitamin D_3 status after supplementation. There was found to be a significant difference between the serum levels before and after supplementation ($p<0.01$).

It was observed that t(cal) value was 6.23 and t(tab)value was1.76, P=1.09E-05 in one tail pair t-test. Hence it can be concluded that it is significant at 1% level. In two tail pair t-test t(cal)= 6.23 and t (tab)= 2.14 and P=2.18E-05, significant at 1% level.

CONCLUSIONS

The current policy of sun avoidance is creating probable harm for the general population. Ignorance of the effects of portions of the solar spectrum at wavelengths longer than the ultraviolet is due mainly to lack of suitable measurement tools for cutaneous and systemic responses to those regions. But in places where there is a minimal sunlight, food rich in vitamin D, fortified foods in vitamin D and vitamin D supplementation should be consumed to avoid the vitamin D deficiency. More 2 months supplementation is recommended for increasing serum levels to sufficiency category

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